



THE
ONTARIO WATER RESOURCES
COMMISSION

BIOLOGICAL SURVEY

of the

SYDENHAM RIVER WATERSHED

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BIOLOGICAL SURVEY OF THE
SYDENHAM RIVER WATERSHED

(Lake St. Clair Drainage)

1967

by
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Biology Branch
March, 1969

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SUMMARY

To determine the presence and extent of water quality impairment on the Sydenham River, a biological survey was conducted during May and September, 1967. Bottom fauna were sampled and water samples were collected for bacteriological, algal and chemical analyses for most of the 43 stations on the watershed.

With few exceptions, bottom faunal communities at stations on the east Sydenham were indicative of water of satisfactory quality. Minor qualitative impairment was evident a half-mile below the Strathroy retention ponds while a community typical of an organically enriched situation was recovered at the point where the river transects the tenth concession Brooke Twp. road. Coliform bacterial counts exceeded Commission objectives by a factor of 10. On Brown Creek above Watford, water quality was impaired chemically although a healthy bottom faunal community was recovered. From Alvinston to Dresden, benthic communities were unimpaired and attained their greatest diversity. In September, wastes from the Dresden area were responsible for a slight qualitative alteration of the macroinvertebrate association, a half-mile below the town.

On the north Sydenham, water quality was impaired below Petrolia and Brigden on Bear Creek and below Oil Springs on Black Creek.

Benthic communities in the Petrolia area revealed organic pollution both below and above the outfall of the sewage stabilization ponds. Also, coliform levels were excessive in both sections. Slight recovery in the benthic association was evident some five miles downstream. Below Brigden at the Hwy. 80 bridge, a reduction in diversity of the bottom fauna and increases in BOD and suspended solids levels revealed degradation in water quality. Sampling on Bear Creek near Wilkesport revealed water of satisfactory quality.

Below Oil Springs on Black Creek, the benthic association was seriously impaired and was typical of a toxic situation. Concentrations of all chemical parameters were elevated above the control station and algal populations were high. Septic tank runoff was likely responsible for the increased algal production but the absence of bottom organisms was not explained by the analyses completed as none of the chemical parameters determined was of a toxic concentration. The influence of the Oil Springs tributary was evident below its confluence with Black Creek, as population diversity was depressed below that of the upstream control station on the latter where conditions reflected water of unimpaired quality. From Wilkesport to Wallaceburg on the north branch, benthic associations were indicative of good water quality with the exception of one station $1\frac{1}{2}$ miles below Wilkesport where minor impairment was suggested.

It was evident from biological, chemical and bacteriological sampling, that the main Sydenham River was organically polluted by septic tank runoff from the Town of

Wallaceburg. Wastes from Dominion Glass Co., Ltd., had a local negative effect on the benthos. Gross organic pollution was present below the food processing plant of Libby McNeil and Libby Co., of Canada, Ltd., in August, 1967. Major effects of this company on the river included a reduction in aesthetic quality, a serious depression of dissolved oxygen levels and a corresponding reduction in the diversity and stability of desirable bottom faunal associations.

RECOMMENDATIONS

- 1) A more complete treatment of municipal wastes is required in the Petrolia area where it was evident that organic and bacteriological contamination was present in Bear Creek. When the municipal system is fully connected to the oxidation ponds, the situation will hopefully improve. On the same tributary, more adequate treatment of sanitary wastes is required at Brigden.
- 2) Attention should be devoted to the need for the treatment of domestic wastes in the Oil Springs area and further investigations should be carried out to explain the apparent toxic effect on benthic production in this section of Black Creek.
- 3) Improved treatment of domestic wastes at Wallaceburg is required to prevent organic and bacteriological contamination of the Sydenham River.

- 4) Oil discharged from Dominion Glass Co., Ltd., caused a local impairment of water quality. Steps should be taken to remove this waste constituent.
- 5) Wastes from the food processing plant of Libby McNeil and Libby Co., of Canada Ltd., seriously impair water quality and detract from the aesthetics of the river. Effective treatment facilities are required to alleviate the problem.

INTRODUCTION

In May and September of 1967, a biological survey was conducted on the Sydenham River. Objectives of the survey were to determine the presence and extent of pollution in major urban areas (Wallaceburg, Petrolia, Dresden, Strathroy) and to collect base-line data for the appraisal of subsequent alterations in water quality.

GENERAL DESCRIPTION OF WATERSHED

The Sydenham River watershed occupies a drainage area of some 1052 square miles of prime agricultural land within three counties of southwestern Ontario. Seventy-eight percent of this area lies in Lambton County, 15 percent is in Middlesex County and the remainder is located in the County of Kent. As more than half the watershed occupies the Lambton Clay Plains, turbid water is common throughout. The river is formed by two tributaries, the north and east branches, which merge in Wallaceburg at an elevation of 574 feet.

East Branch

This branch originates about eight miles northwest of London at an elevation of 925 feet and travels 100 miles to Wallaceburg. The average gradient is 3.5 feet per mile, ranging from less than one foot per mile between Dresden and Wallaceburg to 13 feet per mile from Strathroy to its origin. From Alvinston downstream, there is little relief and the flow is usually sluggish.

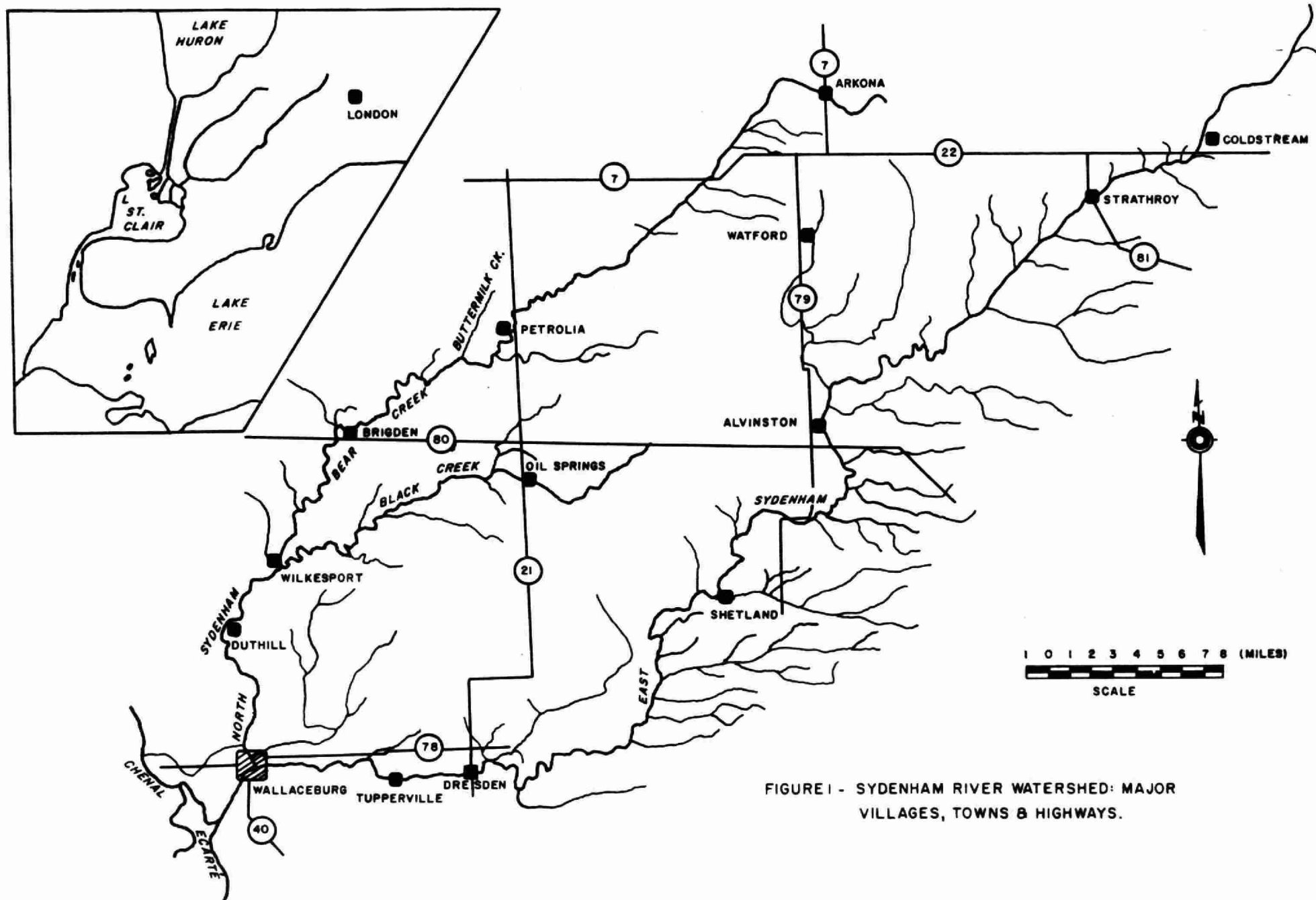


FIGURE 1 - SYDENHAM RIVER WATERSHED: MAJOR VILLAGES, TOWNS & HIGHWAYS.

Flows at three guaging stations on this branch for October, 1966 to September, 1967 are listed in Table 1. Data were obtained from provisional records of the Water Resources Branch, Dept. of Northern Affairs and National Resources. Historically, flooding has been a serious problem in Dresden although the community is 15 feet above the normal river level. It has been estimated that the approximate flow at which flooding begins is 10,800 cfs. (Sydenham Valley Conservation Report, 1965).

Table 1. Flows at five monitoring stations on the Sydenham River (Oct. 1966 to Sept. 1967).

Guaging station number	Location	Drainage area (sq.miles)	Peak flow (cfs)	Highest monthly ave. (cfs)	Annual average (cfs)
East Branch					
2GG-5	Strathroy	66.6	1260 (Dec. '66)	169 (Dec. '66)	72.2
2GG-2	Alvinston	283.	3630 (Apr. '67)	715 (Apr. '67)	276.6
2GG-7	Dresden*	478	4270 (Apr. '67)	1190 (Apr. '67)	-
North Branch					
2GG-6	Petrolia	103	1950 (Dec.)	318 (Mar.)	103
2GG-4	Wilkesport	230	4520 (")	708 (")	236

*Feb. to Sept. '67

Major urban centres of the east Sydenham include Strathroy, Watford, Alvinston and Dresden which support populations of 5646, 1252, 641 and 2378 respectively (1967 Municipal Directory). Industrial development is limited as cash-crop farming constitutes the livelihood of most of the population. Although a few small industries are situated in Strathroy and Watford, a food processing plant in Dresden is the only one of major significance on this branch.

North Branch

The north branch is formed by the confluence of two tributaries, Bear Creek and Black Creek, at Wilkesport (elevation 574 feet). Bear Creek arises at Arkona (805 feet) and runs in a south-westerly direction through Petrolia and the oil fields of this area. The average gradient between Petrolia and Wilkesport is 1.4 feet per mile. Black Creek originates near Inwood and receives a small tributary from the Oil Springs area. From Wilkesport to Wallaceburg, the North Branch is sluggish and the water is quite turbid as it passes through the Lambton Clay Plains. Flow data from provisional records of the Water Resources Branch, Dept. of Northern Affairs and National Resources for the period October, 1966 to September, 1967, are included in Table 1.

Petrolia (population 3669), is located on Bear Creek and is the major urban centre on this branch. Oil Springs, located on a tributary of Black Creek supports 523 inhabitants (1967 Municipal Directory). The economy of both communities is dependent upon oil drilling operations in the area along with manufacturing industries in Petrolia.

Sydenham River: Main Branch

The Sydenham River, from the confluence of the north and east branches to its mouth at the Chenal Ecarte, is only three miles long. The average gradient is less than $\frac{1}{2}$ -foot per mile, the flow is extremely sluggish and the water very turbid. Depths in this stretch are usually from 20 to 25 feet allowing navigation to Wallaceburg.

Minor flooding of this part of the watercourse occurs approximately once every five years when flows from both branches total 10,000 cfs. (Sydenham Valley Conservation Report). In February of 1968, a serious flood caused considerable damage to private dwellings and commercial concerns in Wallaceburg which is situated at the confluence of the two branches.

Wallaceburg, having a population of 10,746, is the largest urban centre in the watershed and the only one on the main part of the Sydenham. Industrial development is extensive. Some of the larger firms produce glass containers, processed food, plated articles and plastics.

WATER USE

Uses of the Sydenham River and its tributaries include recreation, water supply, translocation of wastes, irrigation and livestock watering.

Recreation

Presently, recreational use of the river is limited although there is potential for greater utilization. Only two of seven conservation areas recommended by the Conservation Authorities Branch in their report of 1962 have been established, one at Petrolia and another at Coldstream (six miles north-east of Strathroy). These areas, along with similar developments at Shetland, Campbell (near Newbury) and in the town of Strathroy, provide a variety of recreational endeavours which include picnicking, hiking, fishing and swimming, although the latter is limited by the turbidity of the water. Melwood Park, nine

miles southwest of Strathroy, is a commercial recreation area on the river with 100 campsites and 2 pools for wading and swimming. Nature-trailing and fishing are two additional activities offered at Melwood.

Boating is common on the river from the Chenal Ecarte to Wallaceburg. Although the river is navigable to Dresden on the east branch and to Duthill on the north branch, boating on these stretches is limited. At Wallaceburg, pleasure-boating is of economic significance as the town is a Canadian port of entry from U. S. waters. In 1967, a total of 2,089 U. S. yachts docked at this community bringing 8,030 visitors.

Accurate fishing data are not available but the presence of anglers in boats at the mouth of the river and on docks along the shoreline of the east and north branches just above Wallaceburg, attest to the fact that a sport fishery exists. During this survey, scattered seine hauls indicated the presence of game fish such as pike, largemouth bass and walleye in the lower reaches of each branch. (Table 13) Portions of the Sydenham are used for spawning by a segment of the Lake St. Clair walleye population.

Water Supply

Water for domestic purposes is obtained from the river at Dresden where it is coagulated, softened and chlorinated before distribution. At Alvinston, plans for a water treatment plant using the Sydenham as the supply source are under study.

The river meets the water supply requirements of two major industries in the watershed. Canadian Cannery Limited (Dresden) uses a total of 100 million Imperial gallons annually in its seasonal operation. Dominion Glass Co., Limited in Wallaceburg used an average of 1,100,000 Igpd of river water in 1967.

Translocation of Wastes

Perhaps the major use made of the Sydenham River is the disposal of both municipal and industrial wastes.

Sewage lagoon effluents gain access to the Sydenham at Strathroy and Petrolia. Contamination from septic tank runoff from storm sewers and tile beds is common at Dresden, Wallaceburg and Petrolia. Connection of the Petrolia collector system to lagoons is currently underway. Sewage treatment plants have been proposed for both Dresden and Wallaceburg.

Industrial wastes are discharged to the river, in many cases without adequate prior treatment. The major industry at Strathroy, E. J. Wright (Central) Ltd., discharges untreated wastes with high chromate concentrations in batches to storm sewers emptying into the Sydenham. An industrial park has been proposed, its wastes to be accommodated by an oxidation pond which would discharge to a tributary above the town. Wastes from Imperial Foods (Watford) Ltd., a poultry processing plant, are treated in an aerated lagoon and held in a second retention pond before discharge to Brown Creek. Plating wastes from Androck (Canada) Ltd., also at Watford, are treated by an

in-plant system. In Dresden, most of the problem wastes from the food processing plant of Canadian Cannery Ltd., are spray irrigated. A quarter of the 80-acre irrigation tract is under-drained which results in the periodic introduction to the river of wastes which are high in BOD and suspended solids. In the Petrolia and Oil Springs area, Bear Creek and Black Creek receive wastes from oil drilling operations. Brine solutions from oil separation tanks create high chloride concentrations which, along with high sulfate levels, are a more consistent source of wastes than intermittent crude oil runoff associated with heavy rainfalls. Several industries located at Wallaceburg discharge wastes to the Sydenham. Libby, McNeil and Libby of Canada Limited discharge sewage flows varying from 400,000 to 800,000 Igpd to the Sydenham just below Wallaceburg. These wastes contain BOD loadings and suspended solid levels up to 16,000 and 2700 pounds per day respectively. (Ind. Wastes Survey, August 29, 1967). Dominion Glass Co., Ltd., (Wallaceburg) discharges liquid wastes high in solids, oils and COD. Effluents which are high in cyanide, nickel, chromium, copper and suspended solids are emitted to the river by Dura-Chrome Ltd. Luster Corporation of Canada Ltd., discharges treated plating wastes.

Irrigation and Livestock Watering

The Sydenham Valley receives a relatively low average annual rainfall of 28-30 inches. As periodic drought conditions occur yearly, the utilization of river water for irrigation primarily for tobacco crops, is an important water use consideration.

To date, a total of 77 permits have been issued by the Water Resources Branch of the Commission authorizing the use of irrigation water from the Sydenham River and its tributaries at maximum rates ranging from 36,000 to 775,000 Igpd. Seventy-one of these permittees, most of whom are located in Caradoc Twp., utilize water from the upper half of the east branch. Five permittees take water from Bear Creek mainly for fruit irrigation while the single permit holder on the main Sydenham uses water for irrigating tobacco.

BIOLOGICAL EVALUATION OF WATER QUALITY

A meaningful evaluation of water quality may be gained from a study of the aquatic biota. Environmental stresses upon established biological communities result in qualitative and/or quantitative shifts in the aquatic population structure in proportion to the degree of change in water quality.

The aquatic biota is composed of bacteria, phytoplankton, zooplankton, macroscopic bottom-dwelling organisms, aquatic vegetation and finally, fish. Owing to their virtual immobility, bottom fauna provide an excellent picture of water quality during and for a considerable interval prior to a survey.

There is a wide variation in the tolerance of benthic organisms to different types and degrees of pollution. Certain groups are typical of clean water (mayflies, stoneflies, caddisflies) while others are able to withstand adverse environmental alterations (some species of worms and midges). In the polluted situation, the least tolerant organisms are

eliminated while the more tolerant species flourish in the absence of competition. By examining the number of major groups (taxa) and the total number of organisms in a particular benthic community, the quality of the water may be assessed.

METHODS

A total of 43 stations were studied on the entire watershed; 17 on the east branch, 16 on the north branch and 10 on the Sydenham proper.

The major portion of the survey was conducted during May and June of 1967. In early September of the same year, additional time was spent in the Dresden-Wallaceburg area to assess the impact of increased food processing wastes upon bottom faunal associations.

As the river bottom was almost entirely composed of clay or mud and the flow was generally sluggish, sampling was conducted exclusively with a 9x9" Ekman dredge. Three to five dredge hauls were taken in a transect across the river depending upon its width at each station. The sediment haul was sieved through a 24-mesh to-the-inch screen and the macroscopic organisms picked from the detritus remaining. The animals were preserved in 95% ethanol and returned to the laboratory for enumeration and identification. Shoreline niches were sampled qualitatively for 15 minutes with a household hand-sieve.

In an effort to determine the causative relationships and to further clarify water quality, chemical samples were taken at each station along with phytoplankton and bacteriological samples. On the afternoon of August 30 and the early morning

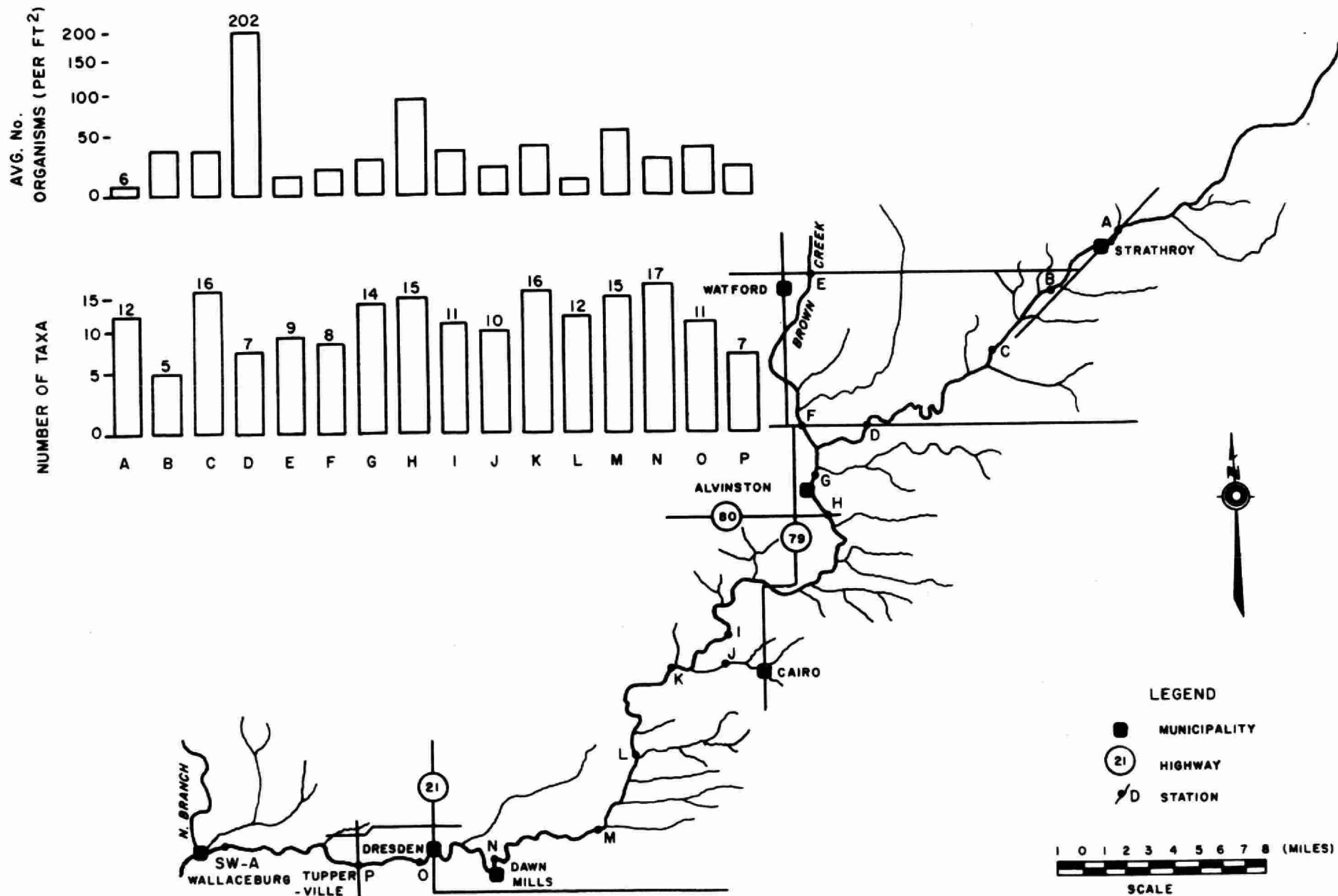


FIGURE 2 - AVERAGE NUMBER OF ORGANISMS AND NUMBER OF TAXA AT STATIONS ON THE EAST SYDENHAM RIVER (MAY 1967)

of September 1, 1967, dissolved oxygen determinations were made at key stations in the Dresden and Wallaceburg areas.

RESULTS

East Branch

Figure 2 indicates the average number of organisms per square foot and the total number of taxa at stations on the east branch. Chemical results are provided in Table 2 and algae counts are listed in Table 9.

Most bottom faunal communities on this branch were diverse with relatively low population densities, indicating water of generally satisfactory quality.

A total of 52 taxa were recovered including ten mayfly genera, six caddisfly genera, six damselfly species and eight taxa of true flies. The number of taxa per station ranged from five (station B) to 17 (stations C & N) with an overall average of 11.5 taxa per station for the branch. Population densities were low, attaining levels greater than 100 organisms per square foot at only one of the 17 stations (D).

Minor impairment of the benthos was noted about $\frac{1}{2}$ -mile below the Strathroy waste stabilization ponds at station B. Dredging (3 hauls) yielded low numbers of pollution tolerant midges and worms. Qualitative sampling of shoreline niches yielded three less tolerant taxa, the damselfly, Enallagma, the amphipod Hyallela and the snail Lymnaea. Mayflies, present at every other station on this branch, were absent from station B. Chemical analyses revealed only slight increases in most parameters over those at control station A.

Table 2. Results of chemical analyses on samples taken at 16 stations on the East Sydenham (May and Sept. 1967). (Results expressed in parts per million unless otherwise designated.)

Station	BOD (5)	SOLIDS		Free ammonia	Total Kjeldahl	Total phosphorus	Phenols (ppb)
		Susp.	Diss.				
A May	1.6	29	315	.05	.46	.15	-
B	2.2	11	327	.05	.58	.23	-
C	1.8	15	333	.05	.46	.29	-
D	2.2	36	298	.07	.39	.23	-
E	4.7	101	245	.05	.58	.35	-
F	1.0	13	323	.05	.46	.10	-
G	1.5	16	282	-	-	-	-
H	1.5	21	271	-	-	-	-
I	2.5	31	311	-	-	-	-
J	3.0	34	380	-	-	-	-
K	2.2	75	301	-	-	-	-
L	NOT SAMPLED						
M	1.3	22	362	.10	.65	-	-
N	-	BROKEN IN TRANSIT					
O May	1.3	24	210	.26	.77	.14	0
	Sept. 1.2	41	335	.10	.66	.06	20
P Sept.	2.0	53	267	.10	.60	.24	

Table 3. Results of coliform bacterial analyses on samples collected at 13 stations on the East Sydenham (May and Sept. 1967). Coliform bacteria per 100 ml.

<u>Station</u>	<u>May</u>	<u>September</u>
A	370	450
B	810	4,400
C	330	-
D	24,000	310
E	250	-
F	100	-
G	180	-
H	44	-
I	110	-
J	1,010	-
K	100	760
L	970	-
N	-	210

At station D, only 3 taxa including midges (Chironomidae), worms and a single riffle beetle, Dubiraphia, were obtained through dredging. The total of 202 organisms per ft² was the highest on the east branch. Although less tolerant forms were obtained from qualitative shoreline sampling, results of mainstream sampling were suggestive of organic enrichment.

Chemical results at station E on Brown Creek revealed the highest BOD, suspended solids and total phosphorus concentrations of the east branch. However, the presence of relatively intolerant organisms such as the mayflies Hexagenia and Caenis suggests that the chemical impairment of the water was temporary and not necessarily indicative of the usual situation.

From Alvinston to Dresden, benthic associations were unimpaired and quite diverse including intolerant mayflies Hexagenia and Ephemera and several caddisfly taxa. However, algae counts were elevated at station K and were typical of a stabilization pond community. Between Dresden and Wallaceburg, communities were less diverse although population densities remained normal. The reduction in diversity is probably the result of the reduced velocity of flow in this stretch of the river.

Results of bacteriological analyses are listed in Table 3. Samples taken below Dresden were not analyzed soon enough after collection to permit an accurate interpretation for this section of the river. Coliform bacterial levels exceeded the Commission objective of 2400 organisms per ml at stations B and D during one of the two sampling periods. While discharge from the Strathroy stabilization ponds was likely responsible

for the levels at station B, it is unknown why levels at D were so high during May.

End-of-August Survey

To determine the effect of the seasonal canning plant wastes from Canadian Cannery Ltd., (Dresden) upon bottom faunal communities below Dresden, a supplemental survey was conducted at the end of August, 1967. Bottom fauna sampling was repeated at station O, about $\frac{1}{2}$ -mile below Dresden, and dissolved oxygen determinations were made on the afternoon of August 31 and the early morning of September 1.

Changes in the structure of the mayfly population at station O in August reflected the deterioration of water quality compared to the spring sampling period. Pollution intolerant mayfly larvae Ephemerella and Hexagenia were recovered in May in densities of one and four individuals per dredge. In August, no mayflies were found and although a few adult larvae could have emerged, the juveniles which constituted the majority of the May population were likely eliminated by wastes from upstream.

This qualitative change in the community structure at station O was the only indication of water quality impairment. The overall population density remained low and there was no indication of significant organic enrichment.

Sixty and 70 percent increases in dissolved and suspended solids levels to 335 and 41 ppm respectively and an increase in phenol concentrations from 0 to 20 ppb were the major changes in chemical quality. Dissolved oxygen levels in

close proximity to the Canadian Cannery plant during the day and the night, hovered around six to seven ppm. Downstream as far as Wallaceburg, values varied between four and six ppm, the lower value being recorded only once at station P (at Tupperville) at 1:30 a.m.

It may be concluded that in August, there was some reduction in chemical quality and an accompanying shift in bottom fauna at station O, although no evidence of significant organic pollution was found.

North Branch

The north branch, with its lower gradient, exhibited less species diversity than the east branch. Figure 3 indicates the average number of organisms per ft² and the number of taxa found at each station. Table 4 indicates the results of chemical analyses while Table 9 provides the results of phytoplankton analyses.

A total of 32 taxa including five mayfly genera, two caddisfly genera, five damselfly taxa and four taxa of true flies were collected from 16 stations. The number of taxa at each station ranged from two to 14, averaging 7.4 taxa per station over the entire branch. Population densities exceeded 100 organisms per ft² at two stations - C and E both in the Petrolia area.

Obvious degradation of water quality was detected below Petrolia as demonstrated by the distribution of mayflies and relative abundance of oligochaetes. Of the eight stations on Bear Creek, only four (A, B, D, H) possessed mayflies. Two of these were controls (A and B) and one was situated on a

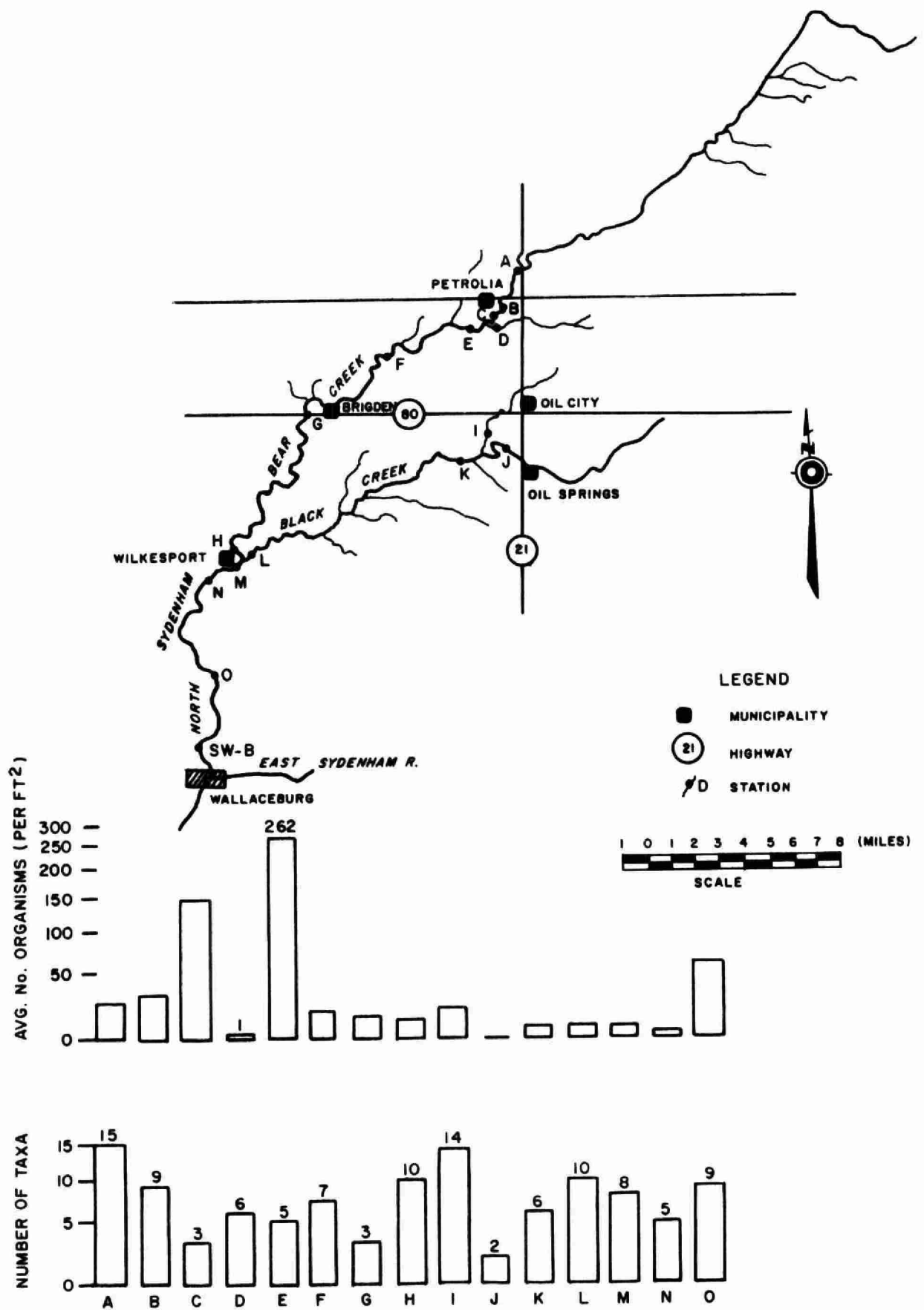


FIGURE 3 - AVERAGE NUMBER OF ORGANISMS AND NUMBER OF TAXA AT STATIONS ON THE NORTH SYDENHAM RIVER (MAY 1967)

tributary unexposed to wastes from Petrolia (D). Only at station H (Wilkesport) were they found again. Amphipods were absent from stations B to F.

Stations C and E yielded valuable information regarding the discharge of organic wastes from Petrolia. It was evident from the numbers of organisms and genera at station C that organic wastes were entering Bear Creek between stations B and C above the oxidation pond outfall. An average of 144 organisms per ft², 99% of which were worms, pointed to this fact. The only other organisms present were three midges and a damselfly (Coenagrionidae) which was taken in a qualitative grab. At station E, the average number of organisms per square foot rose to 262 reflecting the effect of wastes from the sewage lagoons. Although 261 of the organisms were again worms, 5 genera were recovered - two taxa through dredging (worms and a single damselfly Ischnura) and three from the qualitative effort (Coenagrion, Libellula and Physa) - all pollution-tolerant taxa. Because the ponds had only been in operation since January, 1967 and were servicing only part of the town, it is doubtful that the associated improvements in water quality would result in a significant improvement in the benthic community by May, 1967.

At station F, the number of organisms was reduced to 18 individuals per ft². Dredging produced only 3 taxa (midges, amphipods and worms) while an additional four taxa of tolerant damselflies (Enallagma and Ischnura), snails (Physa) and leeches (Hirudinea) were found in the qualitative sampling effort. The reduced numbers of worms and slight increase in diversity reflected a reduction in the effect of organic loading at this station as compared to station E.

Table 4. Results of chemical analyses on samples taken at 15 stations on the North Sydenham (May, 1967). (Results expressed in parts per million unless otherwise designated.)

Station	BOD (5)	SOLIDS		Free ammonia	Total Kjeldahl	Total phosphorus	Chloride	Phenols (ppb)
		Susp.	Diss.					
A	3.8	45	361	.20	.71	.16	21	8
B	6.8	12	548	.43	1.30	.47	83	3
C	4.6	72	486	.36	1.30	.31	78	3
D	3.3	42	338	.30	.91	.11	16	3
E	5.8	65	439	.23	.91	.11	71	3
F	5.4	64	654	.36	1.04	.36	142	4
G	6.3	78	560	.36	.87	.15	76	3
H	3.1	47	467	.26	.91	.19	79	2
I	2.9	47	359	.26	.98	.16	17	2
J	5.2	86	726	.46	1.65	.38	180	8
K	4.3	58	626	.36	1.20	.05	132	4
L	3.1	70	492	.20	1.04	.19	79	2
M	2.9	33	477	.30	.98	.10	81	2
N	2.3	26	524	.10	.77	.06	106	2
O	1.2	29	449	.21	.91	.06	57	4

Table 5. Results of coliform bacterial analyses on samples collected at eight stations in the Petrolia area. (May and Sept. 1967)
(Coliform bacteria per 100 ml.)

<u>Station</u>	<u>May</u>	<u>September</u>
A	220.	1,330
B	68,000.	24,000
C	24,000.	14,000
D	130.	-
E	9,000.	138,000
F	190.	2,700
G	1,100.	31,000
H	340.	-

At station G, only three taxa (sludgeworms, midges and the amphipod, Gammarus) were recovered in very low numbers. The accompanying increases in BOD and suspended solids levels to 6.3 ppm and 78 ppm respectively, indicated that wastes from Brigden were causing some impairment of water quality.

The benthic association at station H was diverse (10 taxa) and was comprised of representatives of the less tolerant forms such as the mayfly Caenis and the amphipod Hyalolella azteca.

All chemical parameters with the exception of phenol concentrations were elevated over levels at control station A and tend to support the bottom faunal results. BOD levels were highest at station B (6.8 ppm) and with the exception of tributary station D, remained higher until station H. Suspended and dissolved solids were noticeably increased, the latter reflecting a significant elevation in chloride levels which attained a maximum of 142 ppm at station F, below Buttermilk Creek. Total phosphorus levels were high at station B (.47 ppm). While sampling was conducted at stations B, C and E, oil was disturbed from the bottom sediments.

Results of bacterial coliform analyses on samples from Bear Creek are listed in Table 5. At stations below Petrolia on Bear Creek to station E, coliform bacterial levels grossly exceeded the OWRC objective of 2400 organisms per 100 ml in both May and September. The high count at station G in September suggests that domestic wastes from Brigden were gaining access to the creek.

On the Black Creek below Oil Springs, substantial impairment was evident at station J where the bottom faunal association was typical of a toxic situation. No organisms were recovered from three dredge hauls and only two tolerant taxa (Gammarus and Enallagma) were found during qualitative sampling. Algal populations at J were greatly augmented over those at control station I (2,079 a.s.u. and 192 a.s.u. respectively) and the levels at K (579 a.s.u.) reflected the influence of the Oil Springs tributary. BOD levels (5.2 ppm) and total phosphorus concentrations (.38 ppm) were high. Levels of suspended and dissolved solids (86 and 726 ppm), free ammonia (.46 ppm) and total Kjeldahl nitrogen (1.65 ppm) were the highest found on the north branch.

There was an obvious impact by this tributary on the fauna of Black Creek at station K immediately below the confluence of the two branches. The number of genera dropped from 14 at station I above the tributary to six below it at station K.

With the exception of station N which exhibited limited diversity, benthic populations at the remaining stations of the north branch from Wilkesport to Wallaceburg were diverse and unimpaired.

Sydenham River - Wallaceburg

May Survey

In May, bottom faunal samples were collected at two stations (D and E) between Wallaceburg and the Chenal Ecarte. At these stations, a total of 9 different taxa were

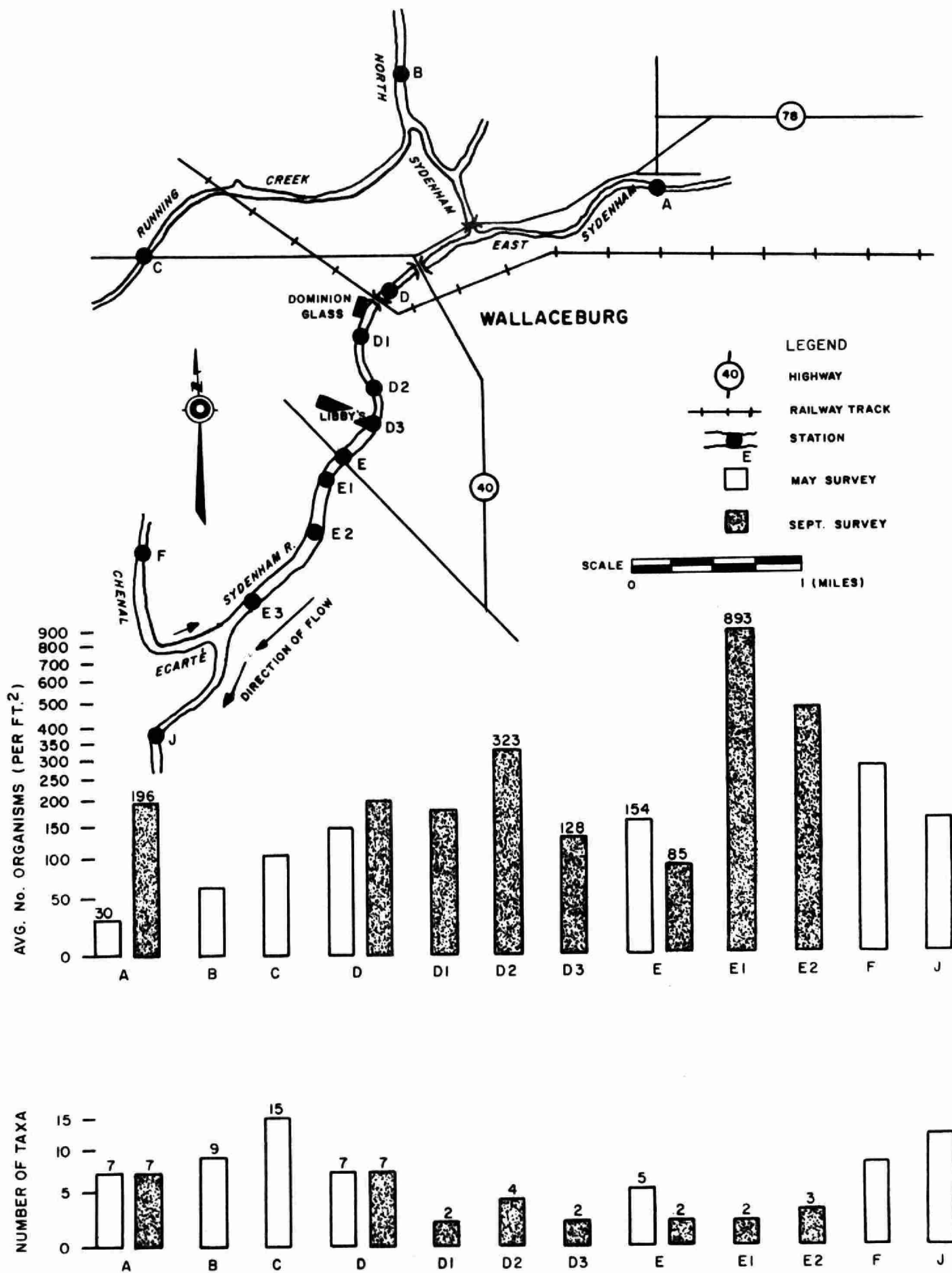


FIGURE 4 - AVERAGE NUMBER OF ORGANISMS AND NUMBER OF TAXA AT STATIONS ON THE SYDENHAM PROPER (MAY AND SEPT., 1967)

found (7 taxa at D and 5 at E) with three common to each. The mayfly Caenis was recovered at both stations. The average number of organisms at each station was approximately 150 per ft², 96% of which were worms. These data compare to a total of 12 different taxa for the control stations (7 taxa at A and 9 at B) and population densities of 30 and 61 organisms per ft² at stations A and B respectively. The amphipods Gammarus and Hyallolella were present at the control stations but were not obtained at either station D or E.

These results are indicative of an organically polluted situation in and below Wallaceburg and are supported by chemical and bacteriological data listed in Tables 6 and 7. At stations D and E, BOD levels were among the highest in the Wallaceburg area (4.8 and 4.0 ppm respectively). Solids, free ammonia, total Kjeldahl nitrogen and total phosphorus levels were increased at these stations, the highest levels for most parameters being at station E which reflects the impact of the total waste loading of the Town of Wallaceburg.

Bacteriological results are listed in Table 7. Although the chilled samples were not analyzed until three days after collection, it may be concluded that coliform bacterial levels approximated or exceeded the OWRC objective (2,400 per 100 ml) at stations D, E and J.

End-of-August Survey

In late August, 3 stations (D1, D2, D3) were added between D and E and three more (E1, E2, E3) were situated between station E and the Chanel Ecarte. Late summer populations at stations D and E were compared with populations

Table 6. Results of chemical analyses on samples taken at stations on the main Sydenham in the Wallaceburg area in May and September, 1967.
(Results in parts per million unless otherwise designated.)

Station	BOD ₍₅₎	SOLIDS		Free ammonia	Total Kjeldahl	Total phosphorus	Phenols (ppb)
		Susp.	Diss.				
A May	3.4	48	338	.08	.91	.26	2
Sept.	1.8	48	284	.08	.78	.25	0
B May	4.2	24	390	.16	.98	.18	2
Sept.	.6	11	221	.02	.46	.14	0
C May	2.2	12	133	.05	.52	.22	-
Sept.							
D May	4.8	93	303	.13	.91	.48	-
Sept.	1.2	49	249	.39	.86	.22	2
D1							
Sept.	1.8	64	238	.36	.98	.52	0
D3							
Sept.	6.3	28	254	.08	1.16	.43	50
E May	4.0	46	392	.39	1.04	.46	0
Sept.	3.8	33	245	.16	1.22	.53	0
F May	2.9	4	154	.05	.46	.12	-
Sept.	.8	33	153	.02	.33	.08	0
J May	4.2	18	168	.05	.46	.12	-
Sept.	.6	20	126	.20	.52	.02	0

Table 7. Results of coliform bacterial analyses on samples collected at stations in the Wallaceburg area (May, 1967). (Coliform bacteria per 100 ml.)

<u>Station</u>	<u>May</u>
A	900
B	220
C	420
D	5,000
E	39,000
F	356
J	23,000

found during the May sampling interval. In addition, dissolved oxygen determinations were conducted at the above stations during the early morning and afternoon of September 1, 1967 (Table 8). Chemical results are included in Table 6.

Table 8. Temperature and dissolved oxygen levels of bottom water collected in the early morning and early afternoon of Sept. 1, 1967 from the Sydenham River (Wallaceburg).

		Time	Temp. (°C)	Diss. oxygen (ppm)
A	am	2:05	18.	5
	pm	1:07	20.5	6
D	am	2:55	17.5	4-5
	pm	1:20	20.5	5
D2	am	3:10	17.5	4
	pm	1:30	20.5	4-5
D3	am	3:25	18.	0
	pm	2:00	22	2
E	am	3:35	18.	0
	pm	1:37	20.5	1
E1	am			
	pm	1:43	20.5	0
E2	pm	1:53	20.5	2
E3	pm	2:10	20.5	3

At control station A in August, seven taxa were again found but population densities increased to 196 organisms per ft². This increase was mainly attributable to the presence of 115 larvae of the phantom midge, Chaoborus, previously absent from this station. The life cycle of this organism is

characterized by a seasonal variation in numbers in the aquatic environment. During June when they pupate and emerge, their numbers are low; during September after mating and egg laying their numbers attain a peak as benthic larvae. Commonly found in hypolimnetic sediments of lakes, Chaoborus is able to exist in environments where oxygen levels are low. Dissolved oxygen levels at this station were five and six ppm during the early morning and afternoon of September 1.

Station D, immediately above Dominion Glass Co., Ltd., again possessed seven taxa and a population augmented by 75 Chaoborus larvae. The number of worms were elevated over numbers found at station A and their relative abundance increased from 28 percent of the total organisms at A to 59 percent at station D. Dissolved oxygen levels were lower (four to five ppm) and free ammonia and total Kjeldahl nitrogen increased to .39 and .86 ppm respectively. These results are indicative of moderate organic enrichment.

Below Dominion Glass Co., Ltd., the number of taxa was reduced to two and the benthic association was comprised of 88% sludgeworms and only 22 Chaoborus larvae per ft². The obvious presence of oil observed in the sediment at this station (D1) was undoubtedly greatly responsible for the reduction in diversity and the low numbers of Chaoborus so abundant at other stations. With the exception of total phosphorus levels (.52 ppm) chemical parameters were not significantly different from station D.

About three-eighths of a mile downstream at D2, slight recovery was evident. Four taxa were present and worms

decreased to 67% of the total numbers. Population densities of Chaoborus increased to 105 larvae per ft². Oil was detectable in the sediments only by smell and dissolved oxygen concentrations remained between four and five parts per million.

At station D3, about 75 feet out from the food processing plant of Libby, McNeil and Libby Co., of Canada, Ltd., only two taxa (sludgeworms and Chaoborus) were found. A foamy scum on the surface and bubbling from the bottom were observations noted at and below the plant. Both the sludgeworms and phantom midges decreased significantly in abundance (75% and 30% reductions respectively) reflecting the limiting effects of periodic anaerobic conditions. Oxygen levels ranged from zero in the early morning of September 1, to two ppm in the early afternoon. BOD levels increased to 6.3 ppm, total Kjeldahl nitrogen to 1.16 ppm and phenols to 50 ppb.

Results at station E (half a mile downstream) revealed an even further decline in numbers of Chaoborus and sludgeworms to 63 and 22 organisms per ft², respectively. Oxygen levels were depressed to zero and one ppm during the early morning and afternoon of September 1. Free ammonia levels increased to .16 ppm, total Kjeldahl nitrogen to 1.22 ppm and total phosphorus to .53 ppm.

At station E1 a quarter-mile downstream, Chaoborus population densities multiplied to 544 individuals per ft² and sludgeworms to 349 per ft² indicating some alleviation from the prolonged anaerobic conditions at E. Oxygen concentrations were zero ppm on the afternoon of September 1. Downstream to station E2,

the commencement of recovery was evident as midges (Chironomidae), absent since station D2, were obtained and the total number of organisms began to decrease. Oxygen levels during the day rose to two ppm at E2 and three ppm at E3.

Considering spring and fall benthic associations at stations D and E, it was obvious that variation at D was naturally induced while that at E was abnormally upset. In both May and late August of 1967, station D possessed seven taxa although mayflies were absent in August. The average number of organisms per ft² rose moderately from 148 in May to 199 in August, although the number of oligochaetes decreased by about 18%. The increase was due solely to the annual cycle of Chaoborus. At D, its population density increased to 75 times its density in spring.

In clear contrast, the benthos at station E had been seriously degraded from six taxa in May to two taxa (worms and Chaoborus) in August. Impairment was so severe that the worm population was reduced by 85% although Chaoborus increased 17-fold over its May abundance.

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APPENDIX

- Table 9 Algae Counts at stations on the Sydenham River,
May, 1967. (a.s.u. per ml)
- 10 Macroinvertebrates recovered from stations on the
East Branch of the Sydenham River in May, 1967.
(numbers per ft²)
- 11 Macroinvertebrates recovered from stations on the
North Branch of the Sydenham River in May, 1967.
(numbers per ft²)
- 12 Macroinvertebrates recovered from the Sydenham River
in the Wallaceburg area, May and September, 1967.
(numbers per ft²)
- 13 Fish recovered from stations fished on the east
and north branches of the Sydenham River, May and
June, 1967.

Table 9. Algae counts at stations on the Sydenham River, May, 1967.
(a.s.u. per ml.)

Station					
East Branch	Blue-green	Flagellates	Greens	Diatoms	Total
A	5	33	1	1174	1213
B	0	94	137	943	1174
C	0	117	103	981	1201
D	0	10	128	640	778
E	0	37	3	121	161
F	0	25	7	9	41
G	0	113	156	372	641
I	0	25	450	164	639
J	0	39	3	145	187
K	63	2041	2767	4506	9377
L	0	13	42	210	265
M	7	65	155	238	465
N	0	26	51	188	265
O	25	84	546	91	746
North Branch					
A	0	25	7	20	52
B	2	112	12	70	196
C	1	64	P	146	211
D	0	25	1	13	39
E	4	52	6	19	81
F	0	599	1	132	732
G	0	1213	468	751	2432
H	48	36	34	466	584
I	0	136	11	45	192
J	0	1045	382	752	2079
K	0	83	24	442	549
L	3	40	24	176	243
M	0	17	72	126	215
N	31	172	134	160	497
O	0	64	11	39	114
Main Sydenham River					
A	0	2	10	128	140
B	0	101	61	50	212
C	0	2	8	50	60
D	3	1	0	122	126
E	0	7	8	106	121
F	4	16	0	623	643
J	26	32	47	453	558

Table 10. Macroinvertebrates recovered from stations on the East Branch of the Sydenham River in May, 1967 - numbers per ft².

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
STONEFLIES																
<u>Isoperla</u>											1					
MAYFLIES																
<u>Baetis</u>	*		*				*	*	1	*	1	*				
<u>Caenis</u>					5	1	*	*	1	*	2	1	*	1	*	
<u>Ephemera</u>												*	*	*	1	
<u>Hexagenia</u>				*	1	2	11		5			*	4	5	7	1
<u>Leptophlebia</u>															*	
<u>Paraleptophlebia</u>										*						
<u>Pseudocloeon</u>	*		*				*			*		*				
<u>Stenonema</u>			*								2		1			1
<u>Tricorythodes</u>													1			
CADDISFLIES																
<u>Cheumatopsyche</u>			*					2			4	1				
<u>Hydropsyche</u>											1					
<u>Limnephilidae</u>								1								
<u>Neureclipsis</u>													1			
<u>Oecetis</u>									1						1	
<u>Polycentropus</u>	*										1				1	
DAMSELFLIES																
<u>Argia</u>																
<u>moesta</u>											1				1	
<u>Agrion</u>																
<u>maculatum</u>	*		*					*								
<u>Enallagma</u>																
<u>antennatum</u>		*			*	*						*	*	*	*	
<u>(carunculatum)</u>							*									
<u>exsulans</u>				*			*	*	1				*	*		
<u>Ischnura</u>			*		*											
<u>Heterina</u>																
<u>americana</u>								*								
DRAGONFLIES																
<u>Boyeria</u>																
<u>vinosa</u>	*															
<u>Dromogomphus</u>									1							
TRUE FLIES																
<u>Cnephia</u>												*				
<u>Prosimulium</u>			*													
<u>Simulium</u>							*	1								
<u>Nemotelus</u>	*															
<u>Tipulidae</u>	*															
<u>Tabanidae</u>				*						*						
<u>Palpomyia</u>			1				5		5			*	1	4	1	
<u>Chironomidae</u>	5	17	21	199	4	8	11	7	17	18	13	5	43	8	16	2

continued

Table 10 - continued

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
MOTHS AND BUTTERFLIES																
<u>Paragyraetis</u>											1					
BEETLES																
<u>Berosus</u>					1											
<u>Dubiraphia</u>			1	1										1		
<u>Oreodytes</u>										*						
<u>Rhizelmis</u>							*				*			1		
BUGS																
<u>Ranatra</u>				*												
ISOPODS																
<u>Asellus</u>			1		*											
AMPHIPODS																
<u>Crangonyx</u>																*
<u>Hyallolella</u>																
<u>azteca</u>	*	*	*		*		*	*	*				*	*	*	2
<u>Gammarus</u>															*	*
CRAYFISH																
<u>Orconectes</u>	*									*						
MOLLUSCS																
<u>Sphaeriidae</u>	1					5	*	56		1	2	*			1	
<u>Goniobasis</u>								24								
<u>Gyraulus</u>			1									*				
<u>Lymnaea</u>		*	*						*				*			
<u>Physa</u>	*		*			*		*						*		*
<u>Unionidae</u>						1							1			
FLATWORMS												4		*		
WORMS		21	13	2	3	1	*	2	4	1	1	3	1	2	12	14
LEECHES							*	1			1					

*present in qualitative sample

Table 11. Macroinvertebrates recovered from stations on the North Branch of the Sydenham River in May, 1967 - numbers per ft.².

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
MAYFLIES															
<u>Baetis</u>									*						*
<u>Caenis</u>	1	1						1	*		1	2			*
<u>Hexagenia</u>									2		2				
<u>Paraleptophlebia</u>				*					*						
<u>Stenonema</u>	2											1			
CADDISFLIES															
<u>Cheumatopsyche</u>	*														
<u>Polycentropus</u>												1			
DAMSELFLIES															
<u>Argia</u>															
<u>tibialis</u>												*			1
<u>Coenagrionidae</u>			*												
<u>Coenagrion</u>					*								*		
<u>Enallagma</u>															
<u>antennatum</u>	*					*		*	*	*	*	5	*	*	*
<u>exulans</u>		*													
<u>Ischnura</u>		*		*	1	*		*	*				*		
DRAGONFLIES															
<u>Libellula</u>				*	*										
TRUE FLIES															
<u>Simulium</u>	*														
<u>Palpomyia</u>	2	2							1			*		1	
<u>Chaoborus</u>															3
<u>Chironomidae</u>	16	5	3			4	11	1	11		1	2	*	1	2
BEETLES															
<u>Dubiraphia</u>															
<u>Berosus</u>								1	1				1		
ISOPODS															
<u>Asellus</u>															
AMPHIPODS															
<u>Crangonyx</u>														*	
<u>Hyallela</u>															
<u>azteca</u>	*							*	*						*
<u>Gammarus</u>						1	1	*	*	*	1	1			*
GRAYFISH AND PRAWNS															
<u>Orconectes</u>															
<u>propinquus</u>	1	1													
<u>obscurus</u>									*						
<u>Palaemonetes</u>															
<u>kadiakensis</u>									*		*	*			

continued

Table 11 - continued

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
MOLLUSCS															
Sphaeriidae	1	2							*			*			
<u>Ferrissia</u>	2														
<u>Helisoma</u>				*											
<u>Physa</u>		*		*	*	*		*					*	*	*
FLATWORMS	*														
WORMS	1	19	142	1	261	13	3	6	7				5	1	56
LEECHES	1					*									

* present in qualitative sample

Table 12. Macroinvertebrates recovered from the Sydenham River in the Wallaceburg area, May and September, 1967 - numbers per ft.².

	May	A Aug.	B May	C May	D May	Aug.	D1 Aug.	D2 Aug.
MAYFLIES								
<u>Baetis</u>	*							
<u>Caenis</u>			1	1	1			
CADDISFLIES								
<u>Leptophlebia</u>								
<u>Phylocentropus</u>				1				
<u>Polycentropus</u>				1				
DAMSELFLIES								
<u>Coenagrion</u>			*					
<u>Ischnura</u>				*				
DRAGONFLIES								
<u>Dromogomphus</u>				1				
TRUE FLIES								
<u>Palpomyia</u>		1	1	6	*	1		
<u>Chaoborus</u>		115	4		1	75	22	105
<u>Chironomidae</u>	1	23	1	76	3			1
BEETLES								
<u>Dubiraphia</u>		1			*			
BUGS								
<u>Ranatra</u>				*				
AMPHIPODS								
<u>Gammarus</u>	*		*	*				
<u>Hyallela</u>								
<u>azteca</u>	*	1		1				
ISOPODS								
<u>Asellus</u>			1	*				
MOLLUSCS								
<u>Sphaeriidae</u>	1		1	*	1	1		1
<u>Amnicola</u>								
<u>Goniobasis</u>								
<u>Gyraulus</u>	*	1						
<u>Lymnaea</u>				*				
<u>Physa</u>				*				
<u>Valvata</u>								
<u>sincera</u>						1		
<u>tricarinata</u>						1		
LEECHES								
WORMS	28	54	52	16	142	117	155	216

continued

Table 12 - continued

	D3	E		E1	E2	F	J
	<u>Aug.</u>	<u>May</u>	<u>Aug.</u>	<u>Aug.</u>	<u>Aug.</u>	<u>May</u>	<u>May</u>
MAYFLIES							
<u>Baetis</u>							
<u>Caenis</u>		1					
CADDISFLIES							
<u>Leptophlebia</u>							*
<u>Phylocentropus</u>							
<u>Polycentropus</u>							
DAMSELFLIES							
<u>Coenagrion</u>							
<u>Ischnura</u>							*
DRAGONFLIES							
<u>Dromogomphus</u>							
TRUE FLIES							
<u>Palpomyia</u>		1				1	2
<u>Chaoborus</u>	74	4	63	544	211	6	
Chironomidae		1			5	6	6
BEETLES							
<u>Dubiraphia</u>							
BUGS							
<u>Ranatra</u>							
AMPHIPODS							
<u>Gammarus</u>							*
<u>Hyallega</u>							
<u>azteca</u>							
ISOPODS							
<u>Asellus</u>							*
MOLLUSCS							
Sphaeriidae						1	
<u>Amnicola</u>							1
<u>Goniobasis</u>						1	
<u>Gyraulus</u>							*
<u>Lymnaea</u>							*
<u>Physa</u>						*	*
<u>Valvata</u>							
<u>sincera</u>							
<u>tricarinata</u>							
LEECHES						1	1
WORMS	54	147	22	349	252	258	146

* present in qualitative samples

Table 13. Fish recovered from stations fished on the east and north branches of the Sydenham River (May and June, 1967).

	East Branch							SW ¹	North Branch							SW ¹
	B	G	H	K	N	O	A		A	G	H	I	K	L	M	B
Gizzard Shad							*									*
Northern Pike							*									*
White Sucker		*		*	*	*	*		*							*
Hog Sucker		*		*												
Blackhorse Sucker							*									
Hornyhead Chub				*												
Carp													*			
Emerald Shiner					*									*		
Common Shiner	*	*	*	*	*							*	*			
Spottail Shiner							*									*
Rosyface Shiner			*		*											*
Mimic Shiner				*			*									*
Bluntnose Minnow	*	*	*	*	*		*		*	*	*	*	*	*	*	*
Fathead Minnow					*											
Tadpole Madtom															*	
Blackstripe Topminnow														*		
Rock Bass															*	
Pumpkinseed						*							*	*		
Longear Sunfish		*							*			*	*	*	*	*
Largemouth Bass																*
White Crappie							*		*		*					*
Yellow Perch															*	
Walleye																*
Greenside Darter			*	*												
Rainbow Darter				*	*											
Johnny Darter	*						*				*	*				*
Log Perch							*									*
Blackside Darter		*			*								*			
Brook Silverside							*									

¹ Sydenham Wallaceburg

